Attribute-based Access Control Architectures with the eIDAS Protocols

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German electronic identity card

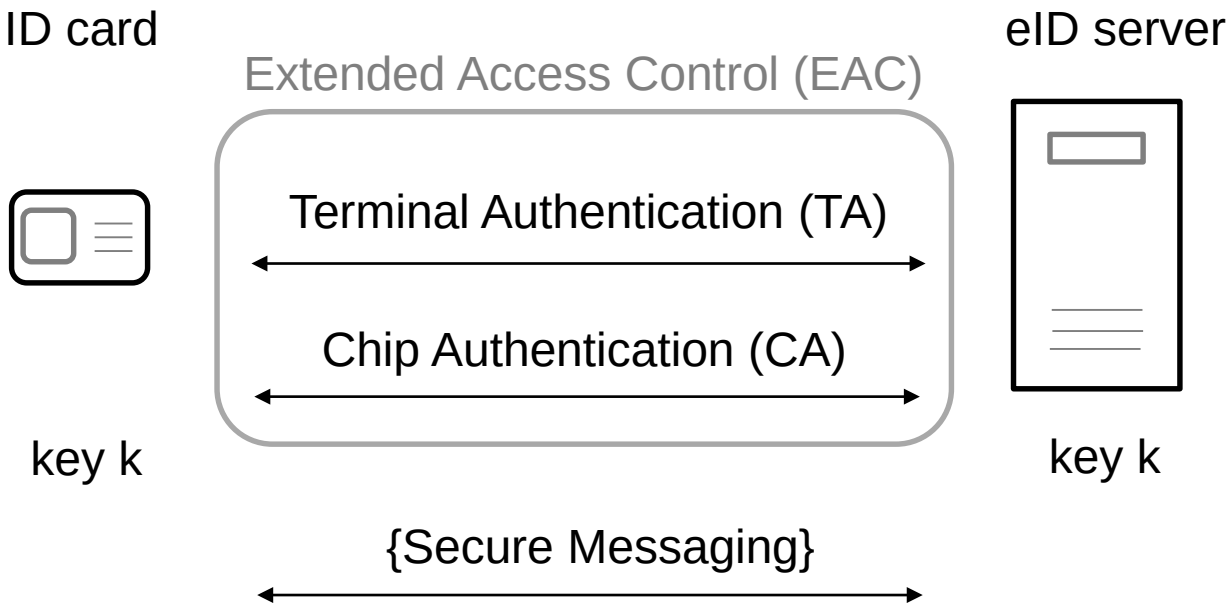
since November 2010

Cryptographic protocols of German identity card:

- also used for machine readable travel documents (ICAO Doc 9303)
- candidate for European eIDAS protocol

  electronic identification, authentication, and trust services for electronic transactions

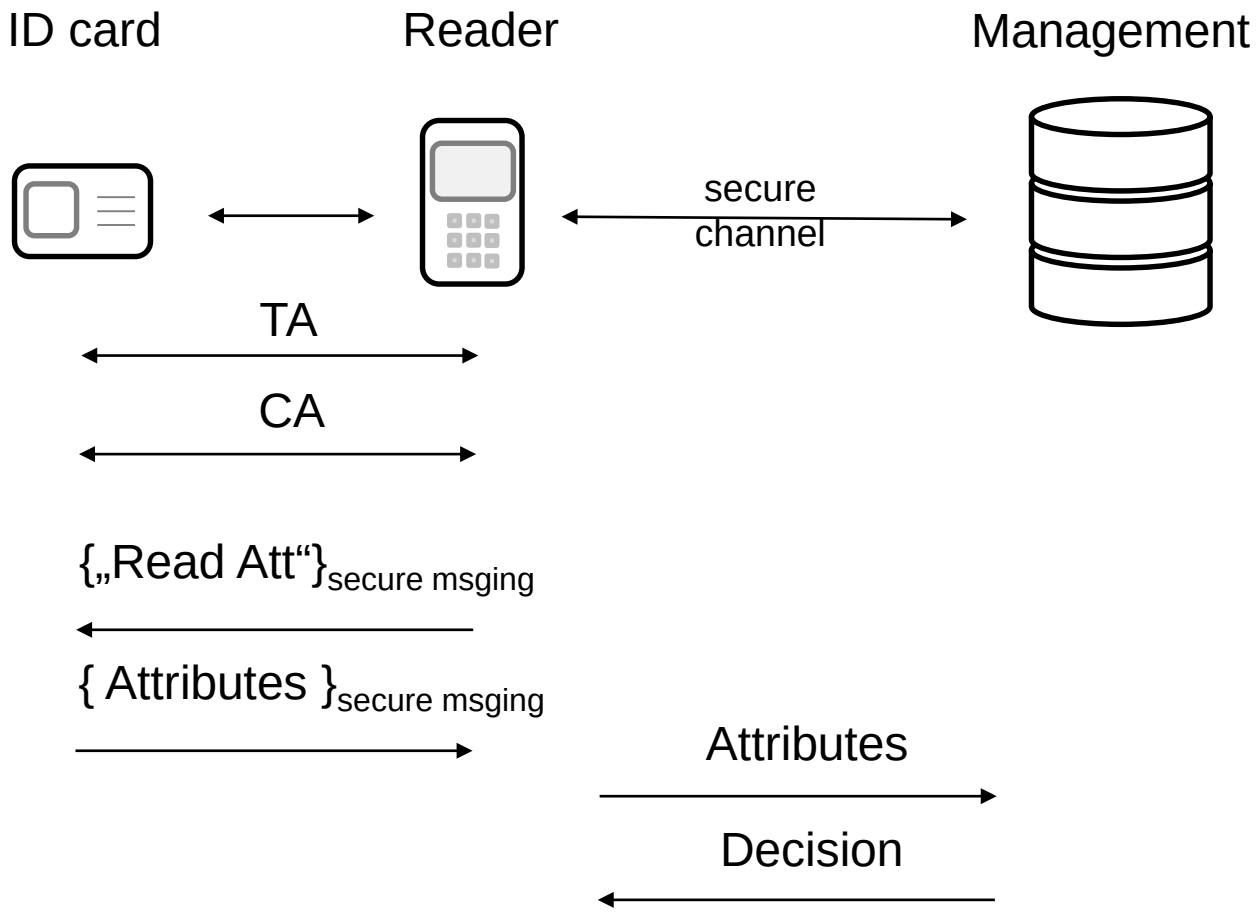
Basic Setting of German eID card



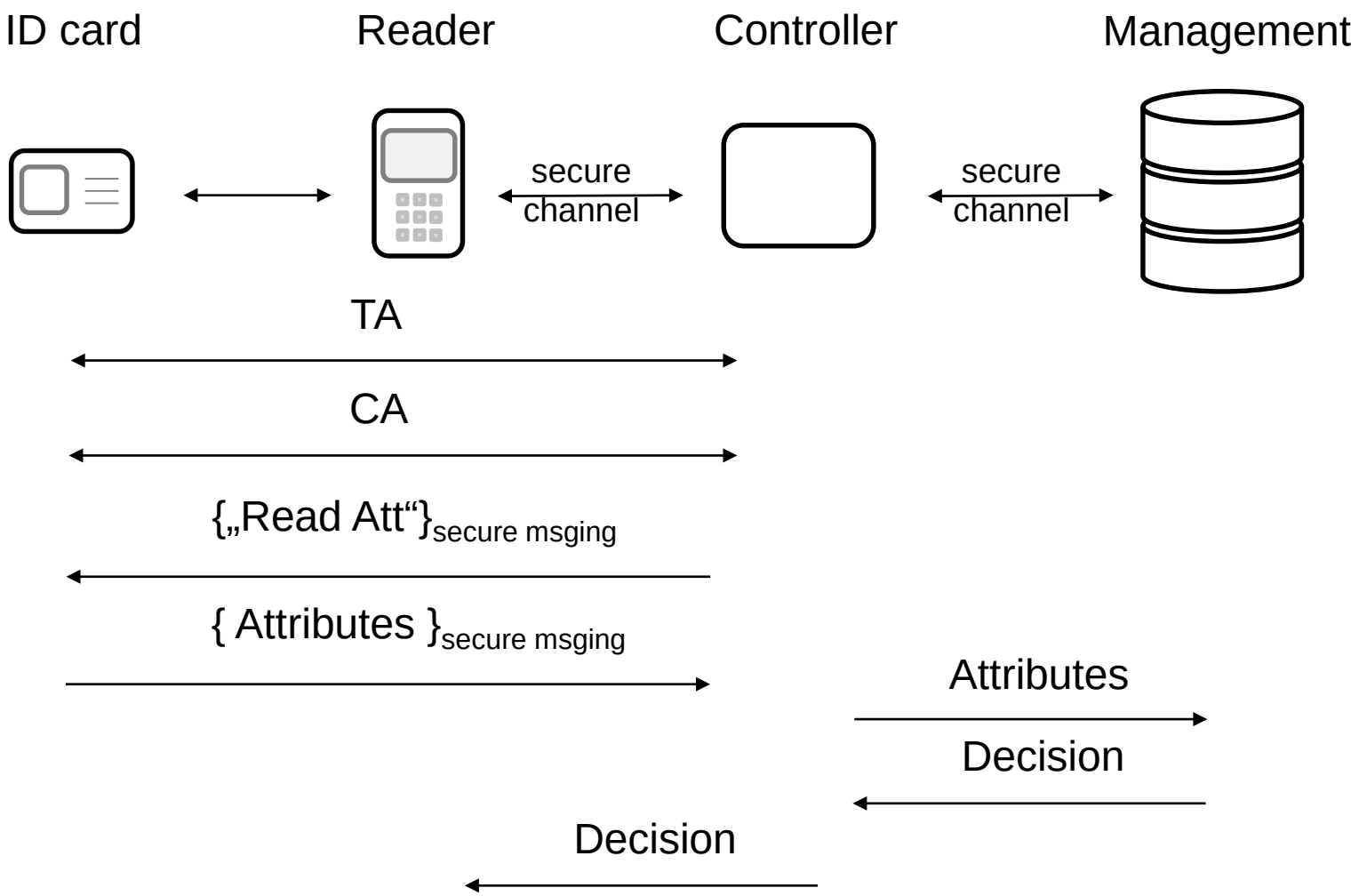
Secure extension to
attribute-based access control
in different scenarios?

Architectures

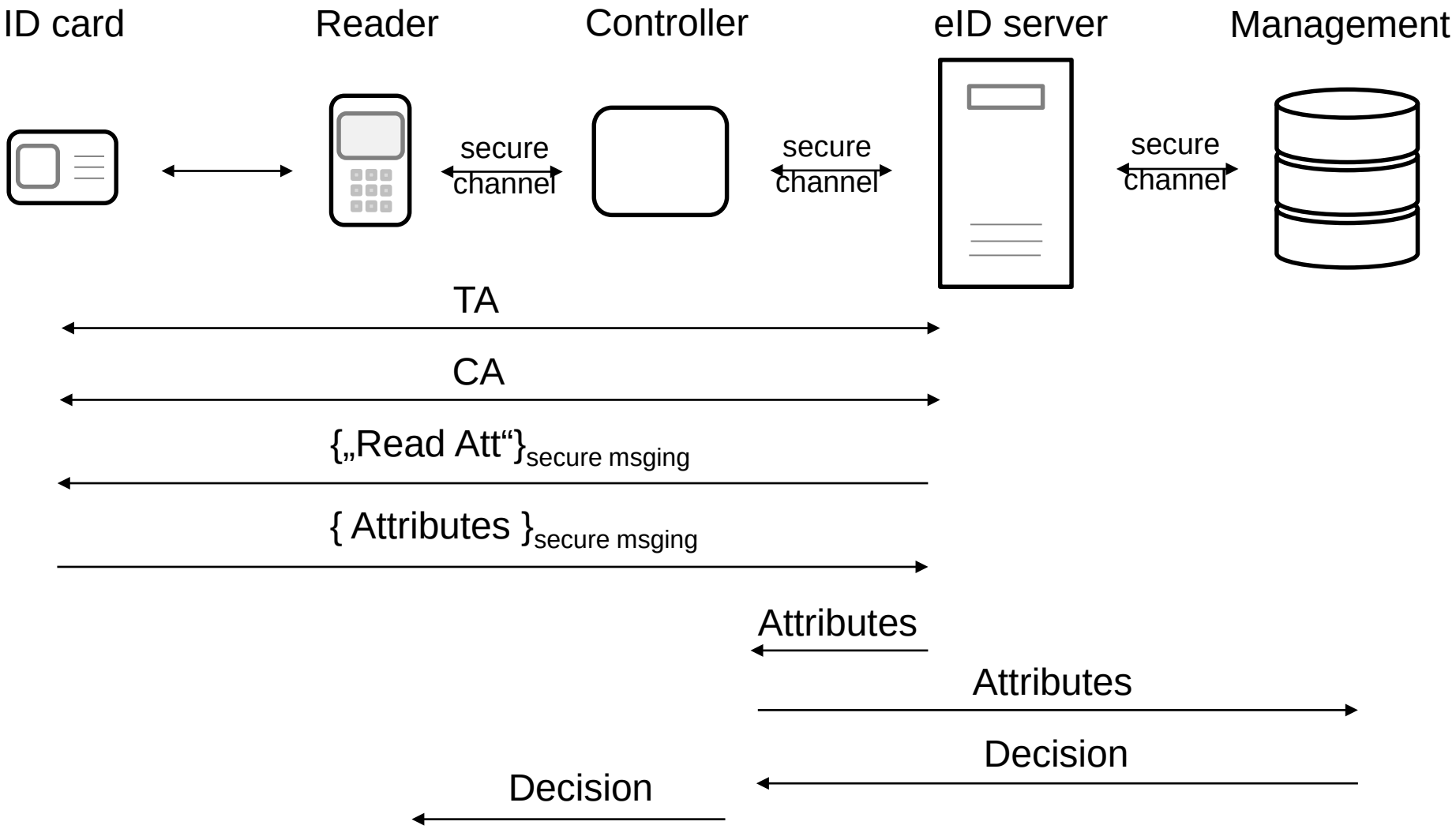
Integrated Architecture



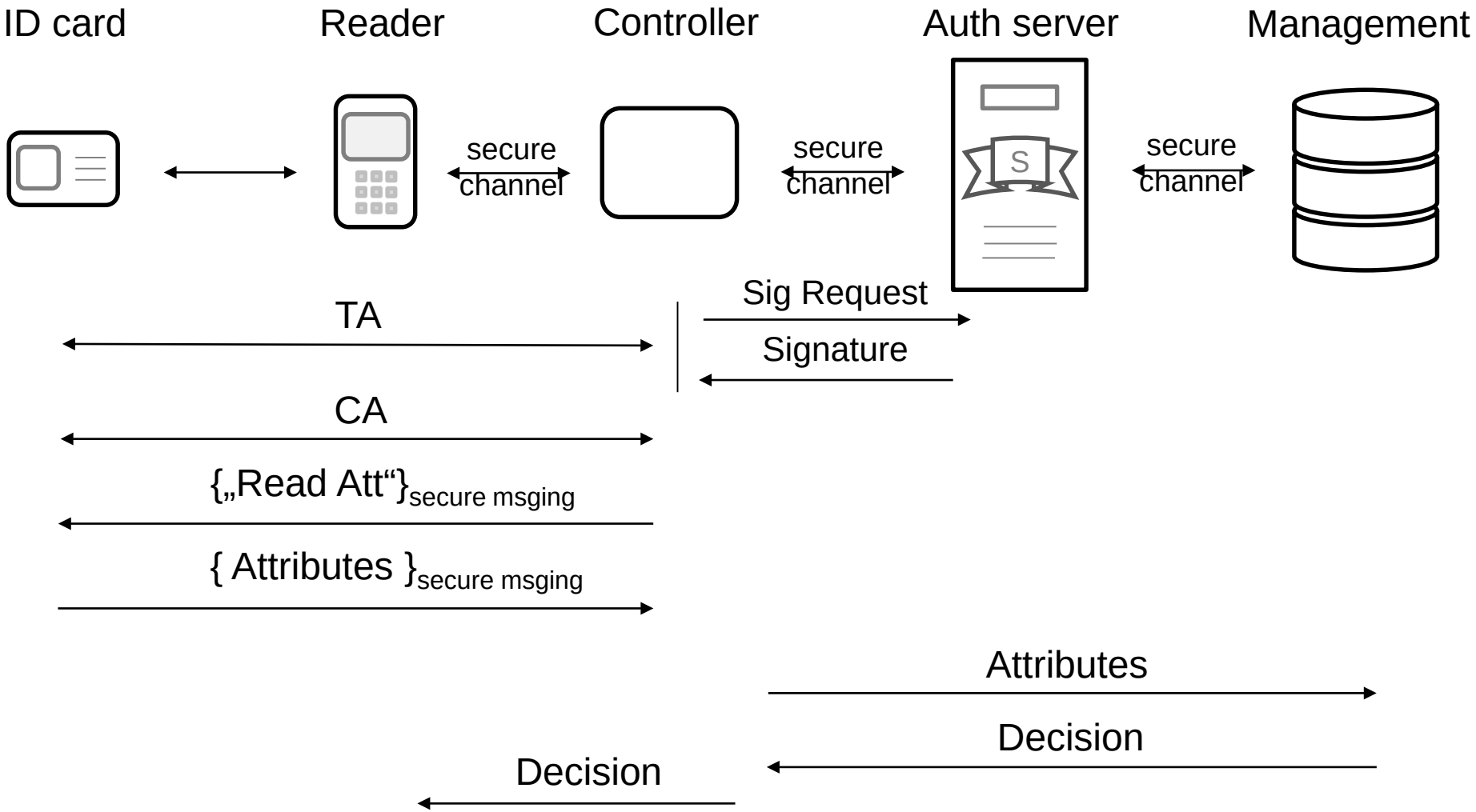
Distributed Architecture



eID-Service Architecture

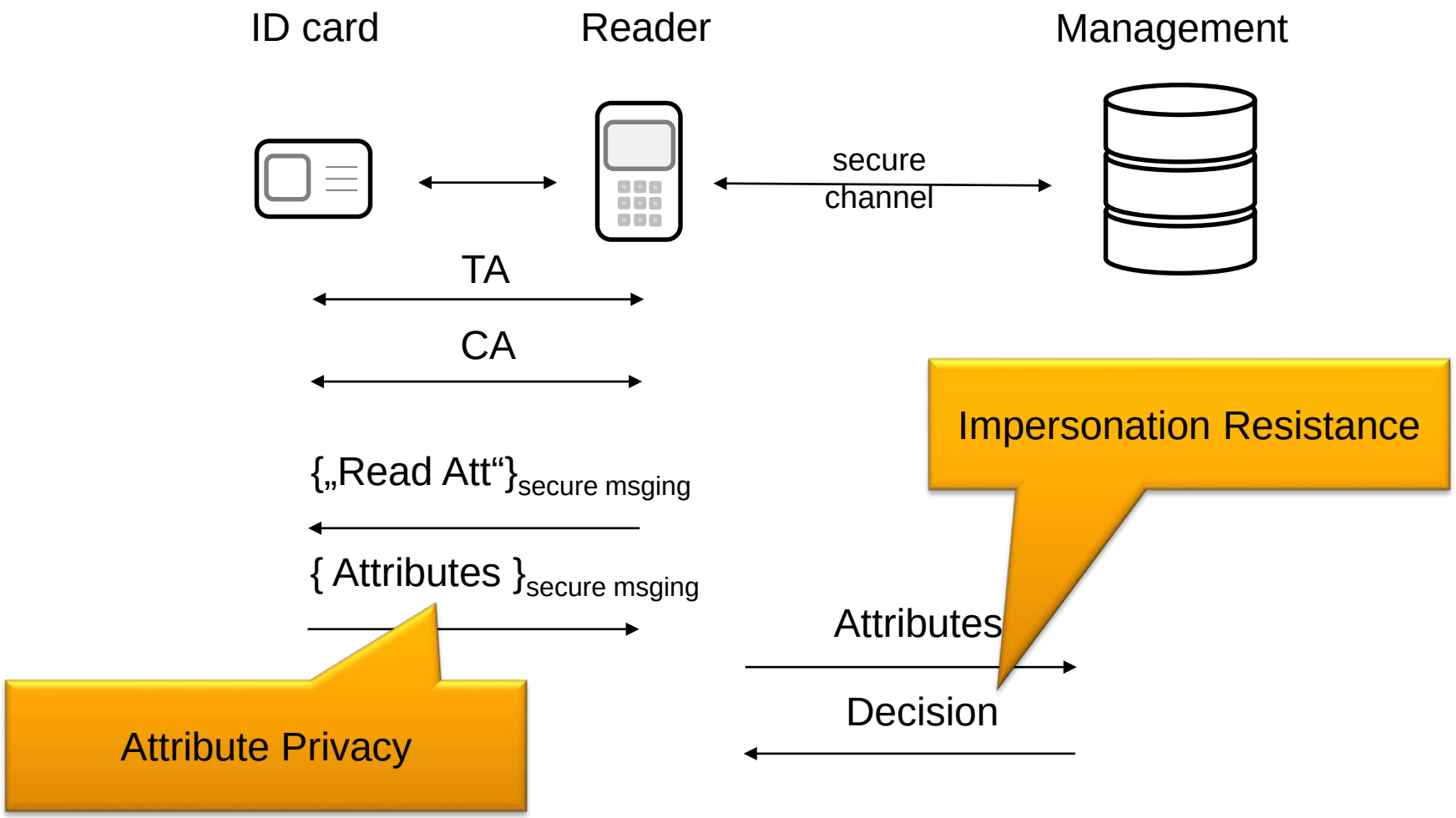


Authentication-Service Architecture

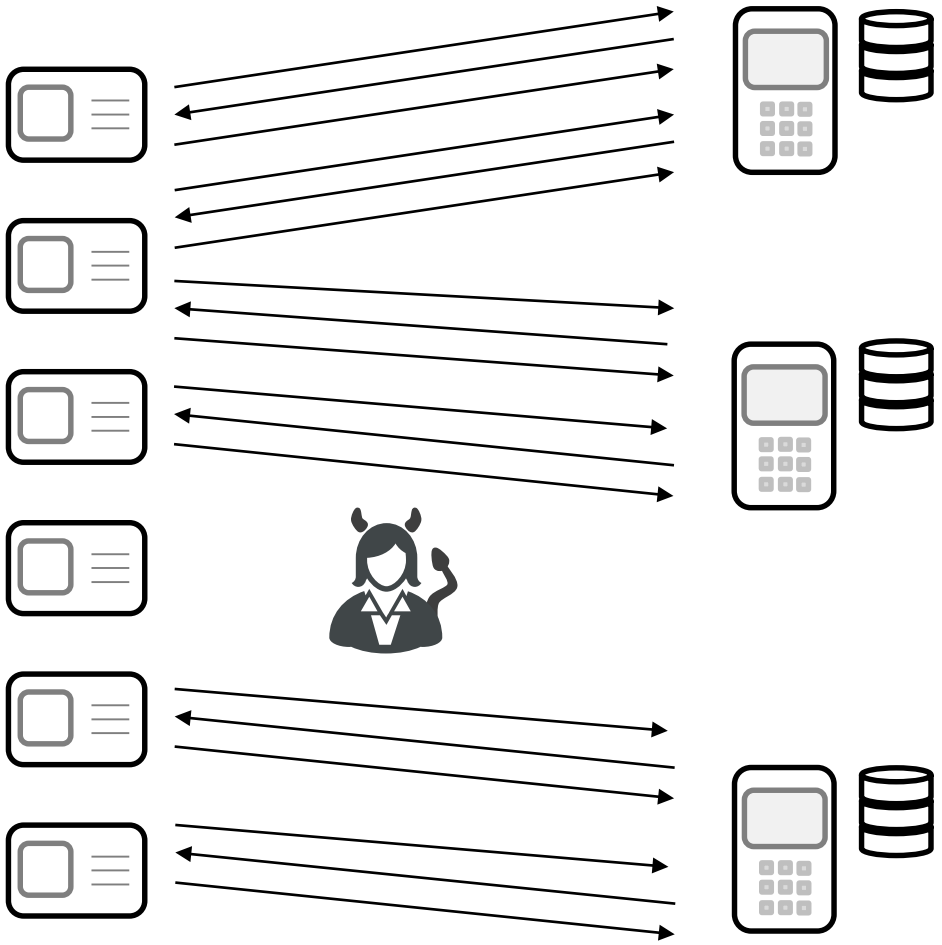


Security

Goals for Integrated Architecture



Dolev-Yao adversary (for both properties)



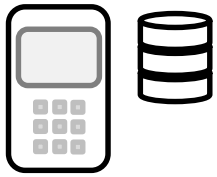
adversary can:

- eavesdrop
- inject/modify messages
- determine schedule
- corrupt parties
- determines data T

requires some notion of sessions and session identifiers

EAC Protocol

session identifier
$SID=(nonce_C, Compr(epk))$



certified key pair sk_C, pk_C

certified key pair sk_S, pk_S

pk_S, $certificate_S$ ←

pick ephemeral esk, epk

Compr(epk) ←

pick $nonce_C$

$nonce_C$ →

$s \leftarrow Sig(sk_S, nonce_C || Compr(epk))$

s ←

terminal authentication

chip authentication

pk_C, $certificate_C$ →

epk ←

pick $nonce^*_C$
$K = KDF(DH(sk_C, epk)\ nonce^*_C)$
$tag = MAC(K, epk)$

tag, $nonce^*_C$ →

$K = KDF(DH(epk, pk_C)\ nonce^*_C)$
verify tag

partner through certificate

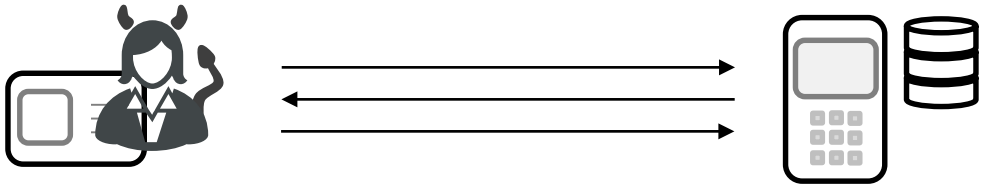
Defining security: impersonation resistance

(a) If party accepts in session SID for partner and attributes A,
then partner also accepts SID and A in some session

(b) at most two SIDs collide, one at a card, one at a reader

Example: „passive security“

formalized in common game-based style



pretends to be card

accepts with SID and A

(a) → can only happen if card has also accepted with SID and A
→ adversary has only relayed data

Defining security: impersonation resistance

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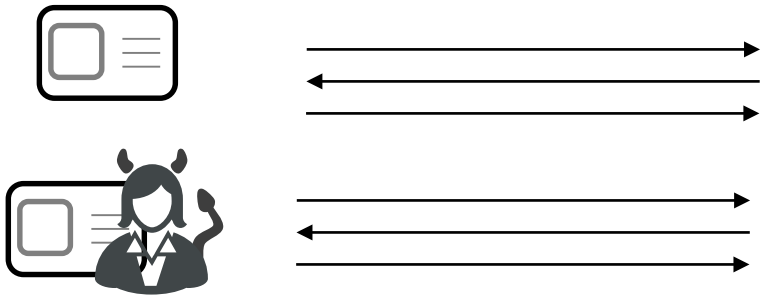
Example: replay attacks



pretends to be card

accepts with SID and A

(b) →
accepts with **SID*≠SID**

(a) → can only happen if card has also accepted with SID* and A
→ adversary has only relayed data

Proving security: impersonation resistance

Theorem:

EAC with secure messaging protocol provides impersonation resistance (assuming random oracles and security of GapDH, MAC, Enc, Sig, Cert).

Proof idea:

EAC is secure key key exchange protocol [Dagdelen, Fischlin, 2010]
+
channel protocol is secure ISO/IEC 10116, ISO/IEC 9797-1 [Rogaway, 2011]

⇒ [Brzuska, 2014]

integrity of attribute transmissions

Defining security: attribute privacy

Adversary cannot distinguish betweendifferent attributes A0 and A1
used in executions between honest parties

formalized again in game-based style

Follows again from security of channel:

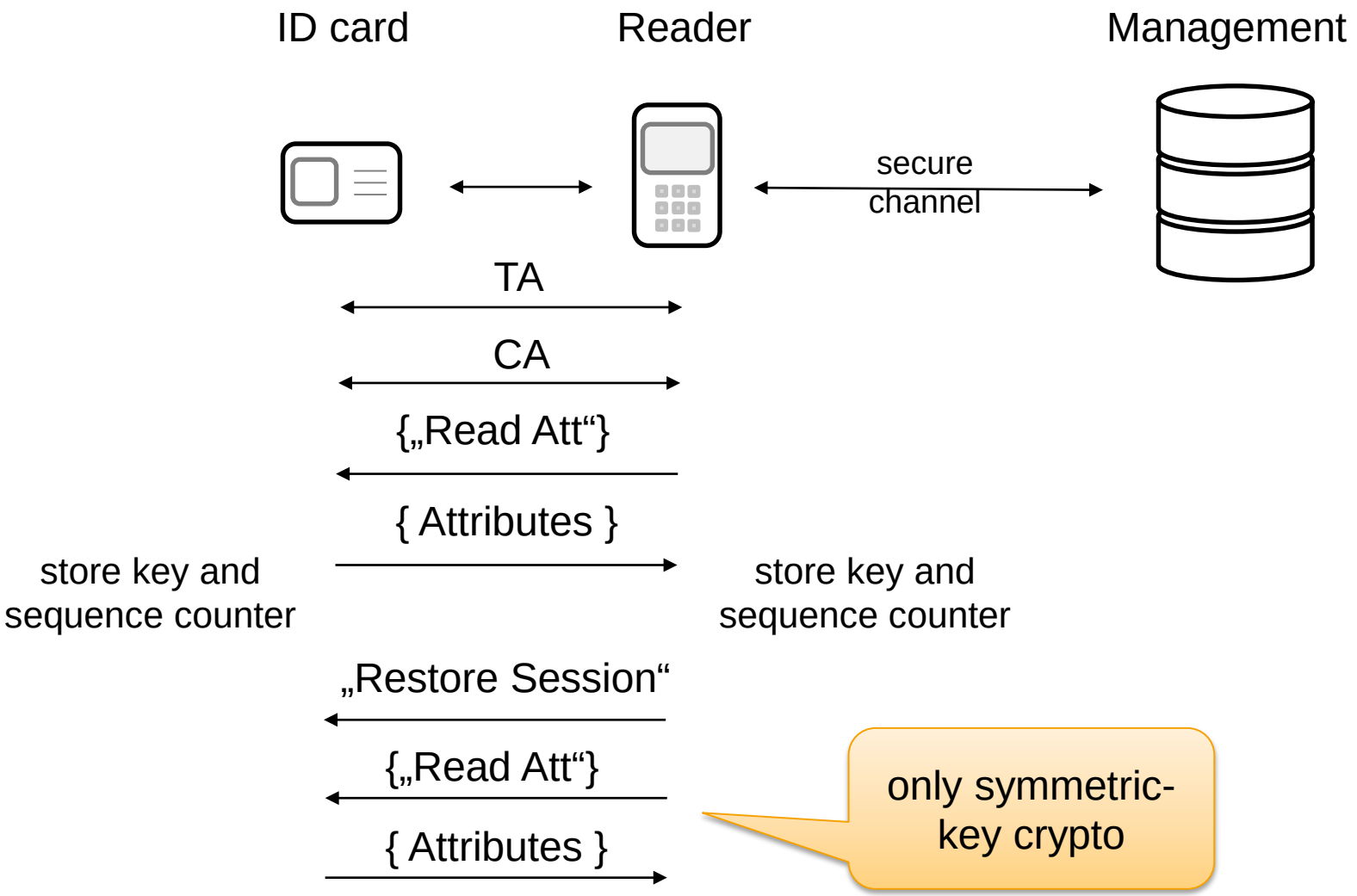
EAC is secure key key exchange protocol [Dagdelen, Fischlin, 2010]
+
channel protocol is secure ISO/IEC 10116, ISO/IEC 9797-1 [Rogaway, 2011]

⇒ [Brzuska, 2014]

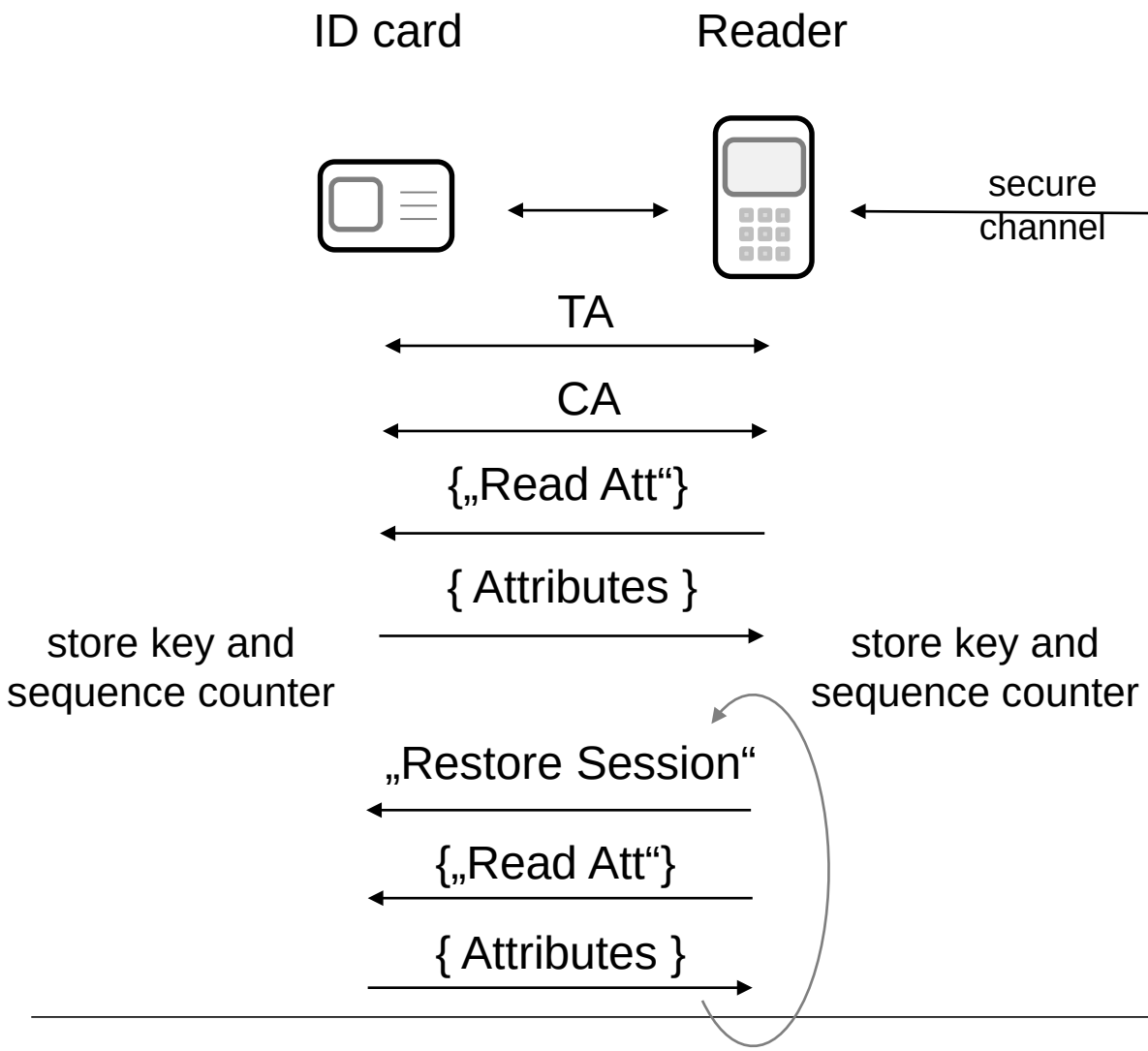
confidentiality of attribute transmissions

Restoring Sessions

Restoring sessions



Restoring sessions



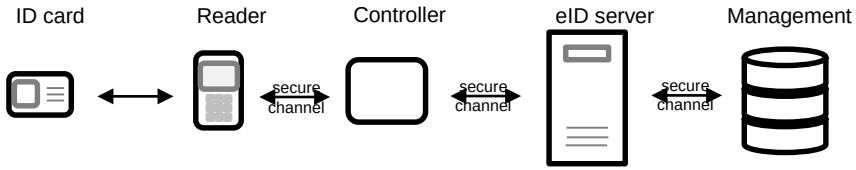
impersonation resistance + attribute privacy still guaranteed

easy to integrate via EAC‘s persistent session contexts

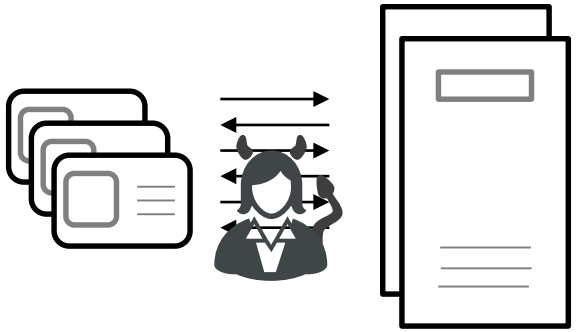
Conclusion

Conclusion

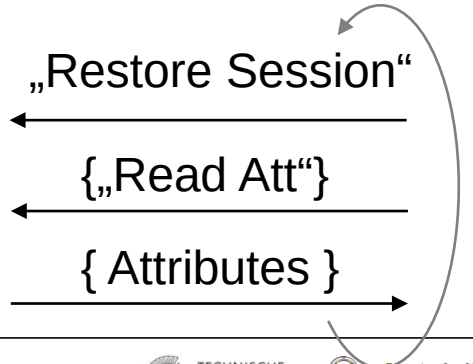
EAC protocol easy to adapt for attribute-based access control



provides strong impersonation resistance and attribute privacy



easy to restore sessions



Thank you!